DIRECTIONAL MICROPHONES: ARE THEY FUNCTIONING PROPERLY WHEN ISSUED?

Authors: Justin Howell, B.S., and Gabrielle Saunders, Ph.D.

VA RR&D National Center for Rehabilitative Auditory Research, Portland Oregon

Introduction and Rationale

Literature indicates that users of hearing instruments with fixed directionality are not reporting real-world directional benefit. Anecdotal evidence suggests that this may be because during manufacturing some directional microphones are misaligned or reversed in orientation in the hearing instrument. This led to the development of this pilot study which addressed the question "Are directional microphones oriented properly when the manufacturer issues them?"

Methods

Measured polar patterns of directional microphones.

Test protocol

Stimuli: narrow band noises (NBNs) calibrated to 65dB at frequencies of:

- 0.25-0.5 kHz
- 1.0-2.0 kHz
- 3.0-6.0 kHz

62 Hearing instruments

- 4 manufacturers
- 16 BTEs, 46 ITE/ITCs

Settings

Flat 20dB linear response with special features disabled

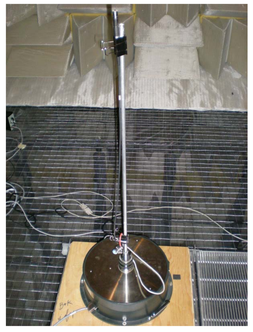
Directionality:

- Omnidirectional
- Hypercardioid (or if unavailable cardioid)

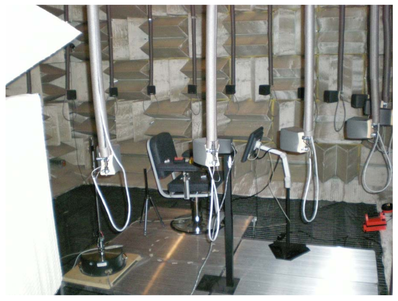
Output verified with Fonix 6500CX test system

Measurements were made in an anechoic chamber

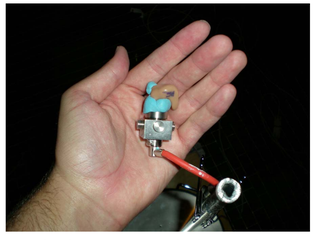
Speaker and turn stand controlled by computer for measurements



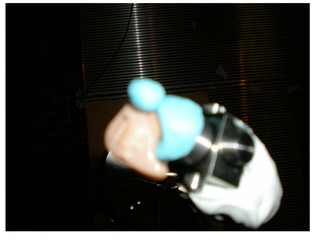
Computer controlled turn stand



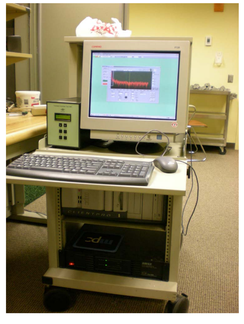
Turn stand and speaker set up in anechoic chamber



Hearing instrument attached to coupler with poster putty. Coupler is attached to a micro-phone for measurements



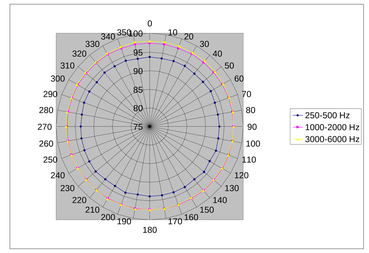
Coupler assembly attached to turn stand

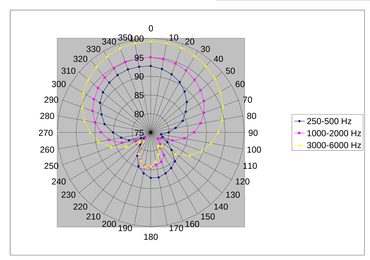


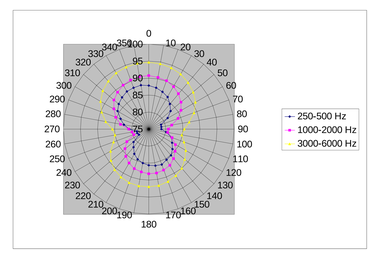
Computer system that controlled the turn stand, sent the signal, took measurements, and dis-played the data.

Abstract

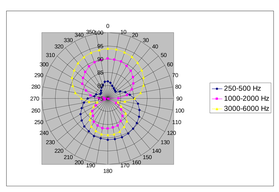
Audiologists have been fitting directional microphones for several years. Literature indicates that users of hearing instruments with fixed directionality are not reporting the benefits found in laboratory testing when wearing the instruments in the real world. This may be because during manufacturing some directional microphones are misaligned, or reversed in orientation in the hearing instrument. The literature provides anecdotal evidence for this and led to the development of this pilot study. Specifically the study addressed the question "Are directional microphones oriented properly when the manufacturer issues them?" The directionality of sixty-two new hearing instruments with fixed directionality was measured using polar plots. Hearing instruments were set to the omnidirectional setting and the hypercardioid (or if unavailable, the cardioid) setting. The hearing instruments were programmed with a flat 20dB response, and all special features were disabled. The polar plots revealed that manufacturer specifications were not met in 56% of the hearing instruments. Identified errors included polar plot reversals, patterns other than the plot specified by the manufacturer, no discernable polar pattern, and omnidirectional patterns while in the directional setting. The results of this study indicate that clinicians should verify directionality prior to issuing to hearing instruments to their patients.

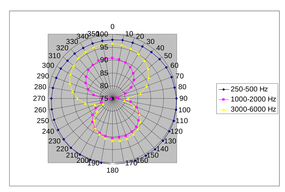


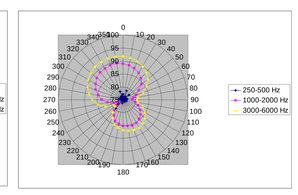




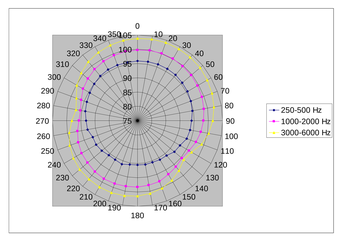
These are examples of good omidirectional, cardioid directional and hypercardioid directional polar patterns



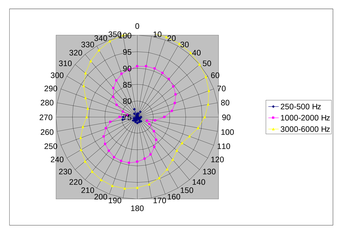




Examples of polar patterns with errors in 250 to 500 Hz band only.



Multiple errors



Multiple errors

Results

Tested and analyzed in pairs:

Pass/fail measure consisted of clinical usability

- Is polar plot the same as the manufacturer's designated shape?
- is polar plot similar to the other instrument in the set?

Common Trends:

- 56 % of instruments tested had errors
- Instruments purchased within 30-60 days prior to the study an had error rate of 52%
- Polar plots for the 0.25-0.5 kHz NBN contained the most errors (52%)
- Polar plots for the 3-6 kHz band contained fewest errors (24%)
- Polar plots varied both within and across manufacturers.
- The output and shape of the polar plot often varied from expected (based on the manufacturers' specifications) and from the second hearing aid in the pair

Results for individual manufacturers:

Manufacturer A.

All instruments tested were purchased within 30 days of the study

- 8/10 ITE/ITC hearing instruments performed as expected
- All of the plots were similar in shape but variations were noticed between the plots
- 2/10 ITE/ITC hearing instruments hearing instruments had errors in 250-500Hz band only

Manufacturer B.

All instruments tested were five-year-old BTEs.

- 2/10 hearing instruments performed as expected
- 4/10 hearing instruments performed as expected in two bands
- 4/10 hearing instruments had multiple errors
- Errors may be due to the age and condition of the instruments
- Needs to be tested with current instruments before conclusions are drawn.

Manufacturer C

All instruments tested were purchased within 30 days of the study.

- 9/12 ITE/ITC and 2/6 BTE hearing instruments performed as expected.
- Variations in the shape of polar plots across NBNs were noted, but plots within a pair of instruments were similar
- 3/12 ITE/ITC hearing instruments had errors in 250-500Hz band only
- 4/6 BTE hearing instruments had cardioid polar plots although the manufacturer specified they were hypercardioid

Manufacturer D

All instruments tested were ITE/ITC aids purchased within 60 days of the study

- 6/24 hearing instruments performed as expected
- 12/24 hearing instruments performed as expected in two bands

Summary

The polar plots revealed that manufacturer specifications were not met in 56% of the hearing instruments. Errors identified included polar plot reversals, patterns other than the plot specified by the manufacturer, no discernable polar pattern, and omnidirectional patterns for a directional setting.

Recommendations:

- Verify that the directional microphone is working before fitting the client with a hearing instrument
- Most manufacturers will provide instructions on demonstrating directional microphones to clients

Future Studies:

- Collect data from more hearing instruments
- Determine why 52% of all errors occurred in the 250-500Hz band of the polar plot.
- Determine the difference in performance between two microphones vs. one microphone with two ports in a hearing instrument.

Acknowledgements

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